ALASKA FOREST RESEARCH

BIENNIAL REPORT FOR 1956 - 1957

STATION PAPER NO. 9

ALASKA FOREST RESEARCH CENTER

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
JUNEAU, ALASKA

R. F. TAYLOR, FORESTER IN CHARGE

CONTENTS

BIENNIAL REPORT FOR 1956-1957

ALASKA FOREST RESEARCH CENTER

No annual report was issued last year and hereafter only biennial progress reports will be issued. This report covers calendar years 1956 and 1957. Much has been accomplished in these two years.

With the development of the pulp industry in Southeast Alaska at Ketchikan and now at Sitka and with further activity scheduled for the Petersburg-Wrangell Unit and Juneau, it became urgent that research expand as well. Research has been needed in forest management in areas not yet studied; the glacier front second-growth, the raised beaches and built-up forelands of the coast to the westward, especially between Lituya Bay and Yakutat. In the vicinity of Yakutat there is a body of some 5½ billion board feet of second-growth, some of it fairly old. These stands differ in many respects from the usual second-growth of Southeast Alaska. Studies were begun to show how they can be fitted in to existing yield tables.

Management research on a small scale was begun in the Interior. Plans are made for a new experimental forest on the North Tongass National Forest where there will be some needed replication of studies made on the Maybeso Experimental Forest and in the Kasaan Bay work area. New studies of North Tongass problems will be started.

Field work on the Survey of the Tongass was speeded up in 1956 and 1957 by using small planes and a helicopter as well as boats. In 1957 only one boat was needed. All other field work was done by combinations of helicopter and small plane, and as a result the field plots were all measured by early in the fall of 1957. Compilation work was also streamlined by IBM methods. The Forest Survey is now turning to the Chugach National Forest and the Interior where photography will be flown in 1958.

Although forest management studies are moving along in Southeast Alaska and the Forest Survey is on schedule, there are still wide gaps in the needed pattern of research. Pathology research is needed. Southeast Alaska's stands are old and full of rot. Forest products utilization studies are needed, and in the Interior all phases of forest research are needed. Our beginning in forest management research in the Interior is only a very small beginning. It has been suggested that until the Interior forest fires can be reduced from over a million acres per year to a reasonable figure perhaps the question of management methods is purely academic. After last year's 5 million acres of burn, this line of reasoning began to sound logical. However, we contend that sooner or later fire protection will be adequate and then proper management methods will be needed.

With this in mind, an analysis of the forest research needs of the Interior is being made. In addition, problems of the Chugach and Yakutat areas will be included. Of course, no analysis is needed to know that a forest survey must be made to locate the forest areas, pin-point the best stands, and determine volumes. No analysis is needed to point out that if forest fires continue unabated the Survey results will soon be inaccurate. Increased attention is being given to these fires--at least, heads are being raised in mild alarm and eventually, perhaps soon, something effective may be done about it. A smoke pall that grounds aircraft for days at a time over a whole summer would normally be looked upon as at least a nuisance if not a danger to national defense. The lack of complaint, the patience, and the attitude by the general public that nothing can be done about it is purely amazing to people from the States. The Bureau of Land Management has been making steady progress on the fire problem but is under-manned and under-financed for adequate control. A concerted attack on the whole problem, from public education to fire research, is needed.

THE FOREST SURVEY

Coastal Alaska

Substantial progress was made on the forest inventory of Southeast Alaska during 1956 and 1957. Collection of field inventory data on 4 of the 5 timber management working circles on the North and South Tongass National Forests was completed.

This project had its beginning in July 1954. Collection of field data on one working circle had been completed in 1955 with an in-Service report published in March 1957.

In the 1956 field season the collection of field data was stepped up as the field parties were increased from three to four. Two Forest Service boats transported and housed the crews. For the first time in Southeast Alaska a helicopter was available for charter, and Survey conducted a test as to its relative efficiency as a means of transporting field parties. Two working circles were completed.

In 1957 the collection of field data was completed on the two remaining working circles using only three field parties and one boat. This was accomplished by the use of a helicopter to transport crews to remote locations that would ordinarily have required two or more days of foot travel from tidewater and return. Some areas would have required as much as five days foot travel, but they were taken care of in one day by helicopter. Float planes were put to more use than previously.

Figure 1.--The motor vessel "Chugach" was used throughout the survey of Southeast Alaska.

Basic resource data were assembled from aerial photos and ground samples on an area of about 3-1/3 million acres of commercial forest land during the biennium 1956-1957. Compilation of the basic data was increased in efficiency and speed of operation by a complete conversion to the IBM system. A coding scheme was set up in 1956 in cooperation with the California Forest and Range Experiment Station and a compilation plan has been written and approved. The IBM Unit at the California Station will provide the tabulations as needed.

Interior Alaska

The big event of 1956 was the appropriation of funds to begin a forest inventory of interior Alaska. The area to be inventoried encompasses about 230 million acres, some of it 100 or more miles north of the Arctic Circle.

Activities in 1956 included an investigation of inventory problems culminating in the writing and approval of a working plan for the inventory project. A start was also made on the collection of volume table data. The Bureau of Land Management is cooperating informally with the Forest Service to make this program a success.

The biggest problem facing the Survey was the almost complete lack of volume tables, cull estimates, growth and yield tables, and suitable aerial photography. The Bureau of Land Management had constructed local volume tables for white spruce and paper birch, but these were not adaptable to an extensive inventory. Consequently, the following work was begun or completed in 1957:

1. A comparative analysis of three aerial film types--infrared, panchromatic, and color--to determine which was best suited for interpretation of Interior tree species was completed. No significant difference was found between the three film types tested. All were equally efficient for identification of tree species and measurement of tree heights. Only four commercial tree species will be recognized in the Interior survey: paper birch, balsam poplar, quaking aspen, and spruce (black spruce and white spruce have been combined). Since there were basically only four tonal or color differences and only four crown variations, one film type was found to be as efficient as another for interpretation purposes.

2. An analysis of defect on 587 felled trees including four species was started to obtain applicable cull factors.

3. Determination was made of criteria for the identification of denuded but productive forest land from aerial photos. (Fires have burned an average of one million acres per year, according to Bureau of Land Management records. Much of this area is forest land.)

4. Measurements of the 587 trees mentioned above were made for the construction of cubic foot and board foot volume tables. Construction of tables will continue. Cubic foot volume tables from a 1.0-foot stump to a 4.0-inch top d.i.b. correlated with diameter at breast height and total height was constructed by adjusting similar volume tables published by the British Columbia Forest Service. Tables were constructed for Interior spruce, balsam poplar, and paper birch-quaking aspen.

5. Stand volume data were collected for the construction of aerial photo stand volume tables. This will continue.

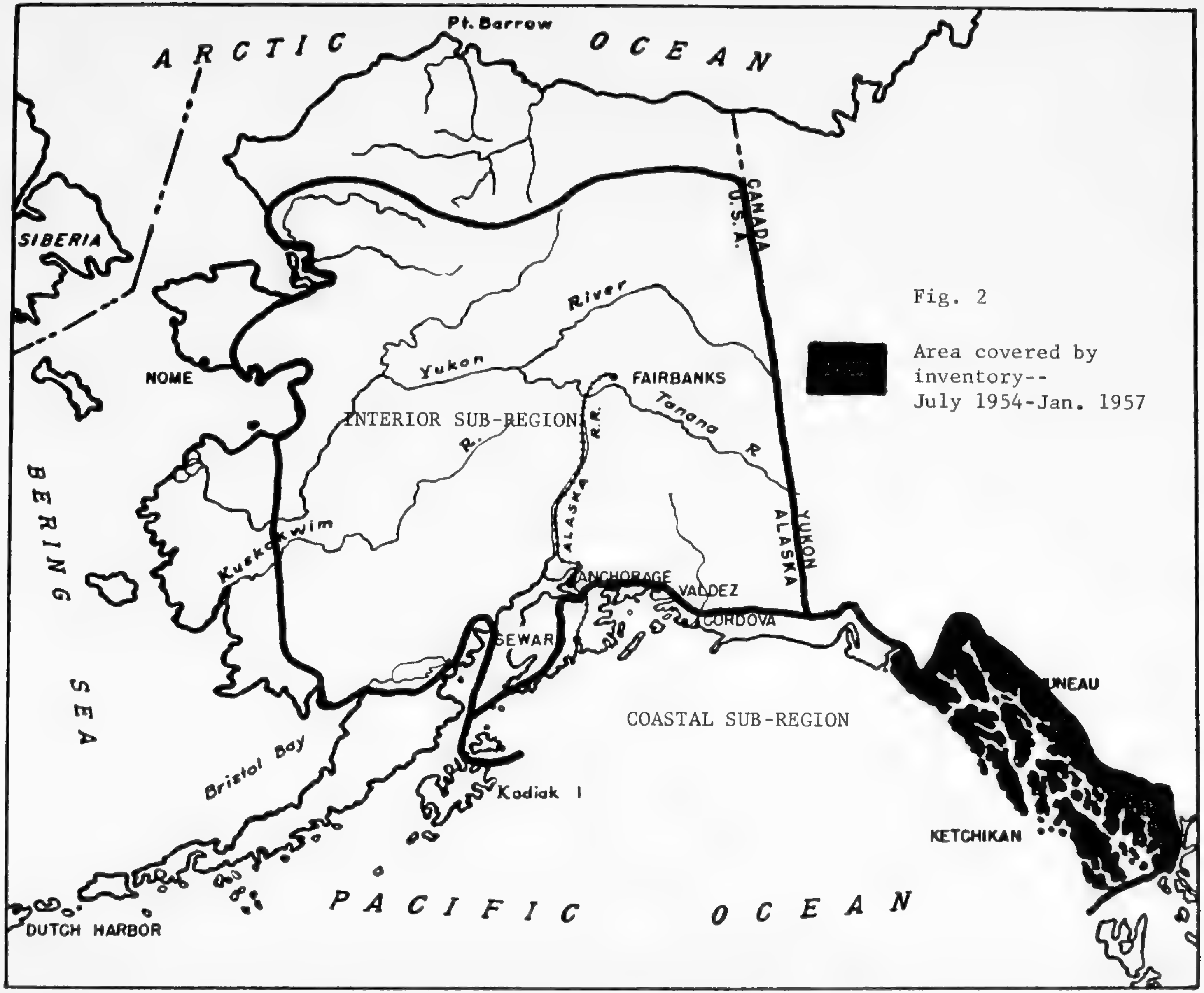

Fig. 2

Area covered by inventory--
July 1954-Jan. 1957

General plan.--The survey method and type of data collected are similar in general to the extensive inventory of the Tongass National Forest. The Interior survey can be intensified, when cooperative assistance is given, by modification of the survey method.

Area sample.--Areas of forest land will be estimated by sampling on strips of aerial photography, at a scale of 1:5,000, flown at 30-mile intervals. One location per photograph will be classified. These locations will be marked systematically along the flight lines. Area estimates of commercial forest land will be determined for each of ten units by forest types, stand-size classes, and crown density classes. Estimates will also be obtained for nonforest and noncommercial or protection forests. A statistical sample of the photo locations will be examined by air to check the accuracy of classification and, where necessary, the proportion of the various classes will be adjusted. Estimates of area will be products of area represented by each location and number of locations per class.

Volume sample.--Volume estimates will be determined from aerial photo stand volume tables. These tables are related to photo measurements of stand height and density and correlated with gross volume per acre by density-height classes. Estimates of defect will be computed by applying percentages to gross volume by species-height classes. Photo measurements will be made on one-half-acre rectangular plots coincident with the area sample. Estimates of total volume will be products of area and mean-volume-per-acre by classes. A sample of the photo volume plots will be field examined to provide a check on photo volume measurements.

Inventory field sample.--Growth, species, diameter distribution and mortality data will be obtained from examination of field plots located at random within the various sampling strata of commercial forest land. These locations will be one-half-acre rectangular plots selected from the volume sample plots.

Plans for 1958

Coastal Alaska

1. Complete reports for the remaining timber management working circles on the North and South Tongass National Forests: Petersburg, Sitka, Ketchikan, and Yakutat.

2. Complete forest type map at 2 inches = 1 mile for the North and South Tongass National Forests.

3. Begin woods utilization study.

4. Begin aerial photography program for the Chugach National Forest.

5. Begin photo interpretation of Chugach photography.

Figure 3.--
Type of helicopter used on the Forest Survey.

Interior Alaska

1. Complete aerial photo stand volume tables for spruce and hardwoods.

2. Begin aerial photography program.

3. Begin photo interpretation of Interior photography.

4. Complete cull analysis of commercial tree species.

5. Complete board-foot volume tables of commercial tree species.

FOREST INSECTS

Barkbeetle Losses Decline

Barkbeetle losses throughout Alaska are at the lowest level in years.

The Sitka spruce beetle (*Dendroctonus obesus* Mann.) confined its activities primarily to the Prince William Sound area and to Port Bazan on Dall Island. The largest outbreak is located in Blackstone Bay near Whittier and involves approximately 2,000 acres. This area has sustained considerable Sitka spruce loss during the past four to five years but losses now appear to be subsiding.

The Alaska spruce beetle (*Dendroctonus borealis* Hopk.) has been relatively inactive during the past two years. Small group losses occur in white spruce on the Kenai Peninsula, the west side of Cook Inlet, and at a few other scattered locations in the Interior, but these losses can be considered as little more than an endemic condition.

An engraver beetle (Ips interpunctus Eichh.) working in the white spruce stands north of Fort Yukon has caused widespread losses. A survey in 1957 indicates that the outbreak has been in existence over five years, reaching a peak prior to 1956 and returning to an endemic condition in most areas by 1957. The total outbreak area, as determined by aerial mapping surveys, covers 1,800 square miles. The cause of the epidemic is not known; however, observations made in 1957 reveal that this insect will, under favorable conditions, breed to large numbers in weakened or dying trees. This includes primarily fire-weakened trees, windthrown trees, and trees dislodged along river banks by flood waters during spring break-up. It is believed that large-scale outbreaks in green timber may result from I. interpunctus first breeding to large numbers in these weakened and dying white spruce.

Table 1.--Age and volume of white spruce loss caused by an Ips interpunctus outbreak in northern interior Alaska

	Currently infested (1957)	1-year-old loss (1956)	2-year-old loss (1955)	3-5-year-old loss (1952-54)[1/]	Total loss
Average cubic ft. vol./acre	0.3	2.3	9.2	28.5	40.3
Percent	0.7	5.7	22.8	70.7	100.0

1/ Tree losses estimated as over five years old were not tallied because of the uncertainty as to the cause and year of death.

Defoliator Activity Declines in Southeast--Increases in the Interior

An eight-year (1948-55) epidemic of the black-headed budworm (Acleris variana Fern.) throughout Southeast Alaska collapsed by 1956. A closely associated outbreak of the hemlock sawfly (Neodiprion tsugae Midd.) remained active in a few scattered locations within Ernest Sound during 1956 and disappeared entirely by 1957.

For the first time in recent years a defoliator has appeared in the white birch stands of interior Alaska. During the latter part of the summer of 1957 the spear-marked black moth (Eulype hastata (L.)) caused defoliation of white birch over a widespread area surrounding Fairbanks (fig. 5). This defoliation was not serious, occurring but intermittently within the affected area. A large population of this defoliator is overwintering in the pupal stage, but several parasitic insect enemies are known to be present. The overwintering pupal population will be studied in the spring of 1958 to determine winter survival, parasitism, and any other factors responsible for pupal mortality. During the summer of 1958 a

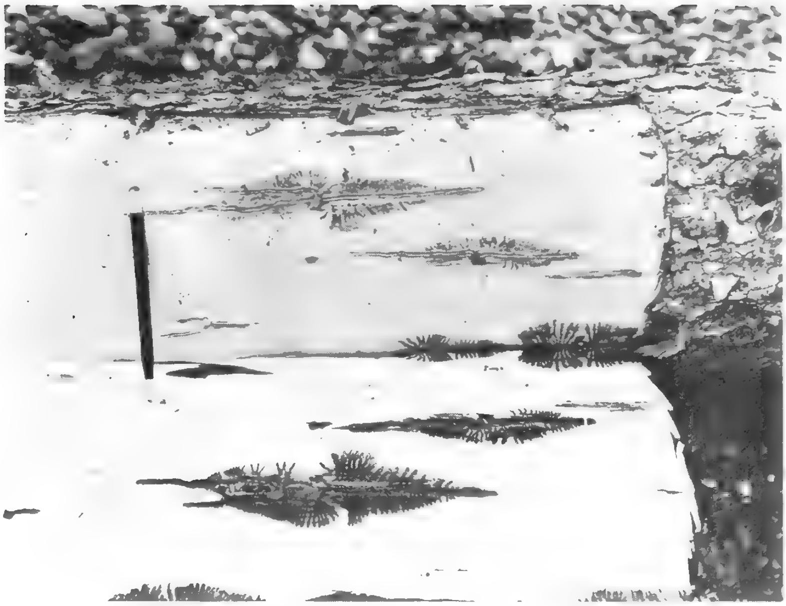

Figure 4.--*Ips interpunctus* gallaries in white spruce. Bark folded down.

preliminary study will be made of the biology and habits of the spear-marked black moth. The effect of defoliation on the white birch stands will be studied and possible control measures investigated.

Cooperative Forest Insect Survey

The detection and reporting of forest insect-caused damage in Alaska involves a tremendously vast forested area with relatively few land managers. To facilitate the collecting of information on forest pests, a cooperative forest insect survey or reporting system has been established. Under this system all forest land managers in Alaska are urged to report any unusual forest insect activity to the Alaska Forest Research Center in Juneau which acts as a clearing house for this information. An entomologist at the Research Center evaluates the reports and determines the need, if any, for further action. Where further action is indicated, an aerial or ground inspection of the infested area is usually made. This may involve a reconnaissance or, if more detailed information is required, an appraisal survey. These surveys are intended to determine the extent, the present status, and the probable future trend of the infestation and possible control or preventive measures that might be employed. The information from these surveys is forwarded to the responsible land management agencies for further action.

Providing training and maintaining a current interest in the program is accomplished through personal contacts in the field between land managers and forest entomologists. This is aided by occasional group training sessions.

Figure 5.--Spear-marked black moth adult x 2.5.

Figure 6.--Spear-marked black moth pupa x 5. Overwinters in this stage in leaves on the ground.

The cooperative reporting system is not presently wholly adequate in detecting all pest damage, primarily because of the immense and remote timbered acreage to be kept under surveillance and the relatively few forest land managers available for this task. A partial answer to this detection problem is found in the forest insect aerial survey program of the Research Center. Each year aerial survey flights are made over a large part of Alaska including flight strips over some of the more remote and less frequently visited timber lands. These aerial survey flights are primarily sample strips and not complete coverage and are, therefore, of most value in detecting the more extensive infestations. Being annual flights, they serve also as a guide in year-to-year changes in insect conditions.

Insect Collecting Expands

Relatively little is known about most of the forest insects in Alaska; therefore, the collection and rearing of these insects is receiving more and more attention. Collecting of forest insects and their damage

has been going on in Alaska for many years but has progressed at a much more rapid rate since 1952 when the first forest entomologist was permanently assigned to the Region.

Field collections of forest insects are made both by entomologists of the Research Center and by cooperators throughout Alaska. Insects collected by cooperators are submitted to the Research Center for rearing and identification. Many specimens are in turn forwarded to the National Museum and elsewhere for specific determination by specialists.

An insect reference collection is maintained in Juneau which primarily includes insect specimens found associated with forest damage and with damage to forest products. Examples of insect-caused damage are also included in this collection. A considerable amount of useful information concerning the distribution, hosts, type of damage, and the biology and habits of the various insects is gained through collection records and the rearing of insects.

Plans for 1958 include emphasis on field collections and will involve some type of systematic field sampling. An expansion of laboratory rearing facilities is also planned.

Large Hemlock Volume Loss Caused by Insect Defoliators

The 1948 through 1955 epidemics of the black-headed budworm and the hemlock sawfly resulted in permanent damage to western hemlock in many areas of Southeast Alaska. During 1956 and 1957 aerial and ground surveys were made to determine the acreage involved and the volume loss sustained as a result of these epidemics.

From aerial mapping surveys it has been estimated that 112,000 acres of hemlock timber suffered light to heavy tree-killing and top-killing. This figure does not include light scattered top-killing which extends over a large area. The 112,000 acres comprise 8,000 acres of heavy loss, 52,000 of moderate loss, and 52,000 of light loss. Losses are most prominent on Admiralty Island, the east side of Prince of Wales Island, the north end of Revillagigedo Island, Mitkof Island, and Lindenberg Peninsula.

To determine volume loss, ground surveys were made in four areas: one a heavy loss area at Thayer Lake on Admiralty Island; the other three in predominately moderate loss areas at Cholmondeley Sound and Exchange Cove on Prince of Wales Island and at Cow Creek on Revillagigedo Island. From these surveys it is estimated that heavy loss is 7,250 board feet per acre, moderate loss 2,700 board feet per acre, and light loss 1,350 board feet per acre. These are net volume losses; the volume of cull material, estimated at 34 percent, having been subtracted.

Figure 7.--Bank cutting of Porcupine River caused by flooding waters. The dislodged white spruce end up down the river on gravel bars serving as breeding material for _Ips interpunctus_.

Figure 8.--Bank on far side of Sheenjek River undercut by high water. Tree in foreground brought down from up river is infested by _Ips interpunctus_.

When combined, the volume and acreage figures amount to a very substantial _loss of 268,600,000 board feet_ or _over one-quarter of a billion board feet_ of what was once a usable forest resource. Additional losses on a few small areas have been salvaged as pulpwood. The vast majority of the loss volume has now deteriorated beyond the point of salvage.

Table 2.--Estimated hemlock volume loss from black-headed budworm and hemlock sawfly epidemics (1948-1955) in Southeast Alaska

	Acres		Bd. ft. vol. per acre	Total
Heavy loss	8,000	x	7,250	58,000,000 bd. ft.
Moderate loss	52,000	x	2,700	140,400,000 bd. ft.
Light loss	52,000	x	1,350	70,200,000 bd. ft.
Total loss				268,600,000 bd. ft.

FOREST MANAGEMENT RESEARCH

Regeneration Studies

In determining, by reproduction surveys, whether a clearcut area is stocked, everything depends upon the examiner's ability to identify an "established" seedling. In surveys made on cutover areas where advanced reproduction was either absent or ignored the counts of new seedlings each year varied greatly on the quadrat as noted in table 3 below. There were 39 seedlings at the end of 1927. Logging was completed in 1926.

Table 3.--Seedling variation on a reproduction plot

Year	During the year this number of seedlings Died	Germinated	Remained
1928	11	30	58
1929	31	8	35
1930	5	14	44
1931	12	11	43
1932	8	8	43
1933	3	3	43

Of the 58 seedlings remaining in the fall of 1928, only 25 lived through 1933. These were the "established" seedlings and they are not so easy to recognize unless they are advanced seedlings that have already become established before logging.

The stocked-quadrat method of determining stocking commonly uses the 4-milacre quadrat. Using this method, the Kasaan District of the South Tongass National Forest[1] found an average of 63 percent stocking of established reproduction on 10 areas cut over from 1 to 4 years before. None had less than 42 percent. New reproduction on the same areas--reproduction that was less than a season old--stocked 73 percent of the plots, on the average. If the examiners are correct in their estimate of "established", these areas are well-stocked, but as shown in the table above the great variation during the first 5 or 6 years in numbers of seedlings makes it questionable whether our definition of a stocked plot is adequate. If one such survey is to be the criterion of whether to seed the area or parts of it, then plots we call stocked had better stay stocked. It might be better to wait until 5 years after logging to determine areas that need seeding to bring up to full stocking, and then to make sure that such areas are not being naturally seeded. If poor seed beds are the cause of understocking, man-spread seed will be no more effective, and unless mice infest that certain area and not others--an unlikely thing--Endrin-treated seed will not be the cure.

First or second year seeding might be reserved for areas that seem to favor a quick invasion of such shrubs as salmonberry, currant, or bracken fern. Areas on cutovers that have very poor seed beds could be mapped for early treatment. The first year's seedlings at least indicate the extent of seed dispersion, and on large cuttings this can indicate the areas to be seeded if it is desired to hurry the establishment of seedlings on these distant areas.

A clearcutting was intentionally made more than a mile in diameter on the Maybeso Experimental Forest to test the distance of seedfall. Logging was completed on this particular area in the fall of 1956 and there was a fair seed crop that fall. How large such cuttings can be depends upon how far sufficient reproduction extends from the seed sources along the edge.

Seed traps were set out in a pattern designed to give data on dispersion, but this was prevented by "unusual weather". Heavy snows and strong winds came during the seed fall. Tops of traps were snow-covered and seed blew off between visits to the traps. So it became necessary, for the present, to rely on actual germination of seedlings to discover how far seed was dispersed into the cutting. During the servicing of the traps, seed was observed on the snow in the very center of the cutting.

For the purposes of the reproduction survey, varying distances from the seed source were represented by four zones extending from the periphery toward the center of the cutting. These were:

1/ From figures supplied by Kasaan District Ranger.

Zone	1	0 - 10 chains
	2	10 - 20 chains
	3	20 - 30 chains
	4	+ 30 chains

A total of 294 1-milacre plots were distributed according to percentage of total area within each 10-chain zone. Plot locations were selected at random from a 2-chain by 5-chain grid superimposed on a map of the cutting. Each 1-milacre plot was rated as stocked or nonstocked according to each of two definitions:

1. Stocked if containing one or more seedlings at least one year old, in good condition, and free to grow; or two or more seedlings less than one year old, in good condition, and free to grow.

2. Stocked if containing two or more seedlings at least one year old, in good condition, and free to grow. This would be a safer criterion than No. 1.

Although the 4-milacre quadrat method is the more common one, the 1-milacre method was used here in order to get better distribution of plots. The 1-milacre method gives results that can be related to the 4-milacre method.

According to common practice a 4-milacre stocking of 70 percent indicates about 1,500 seedlings per acre and a desired stocking. Satisfactory is 40 to 69 percent. These figures by the 1-milacre method would equal 32 percent and about 13 to 31 percent respectively.

The Maybeso mile-square clearcutting has had a 40 percent stocking by the 1-milacre method of advanced, established reproduction, largely hemlock, since it was logged. These are seedlings that were alive under the old-growth and remained after clearcutting. Study of stocking by zones was confounded by these which bore no relationship to distance from the edge of the cutting. After elimination of the advanced hemlock, it was found that stocking decreased markedly with increasing distance from the seed source. (Table 4.)

More will be known about this subject when results of studies of advanced reproduction are in. If it lives in quantity, then the stocking of large cuttings as well as small is assured. Surveys in 1955 showed that this advanced reproduction was very evenly distributed over the cutting with 60 percent stocking by the 4-milacre system. In 1958 the stocking was practically the same. However, until results are available the size of cuttings might better be held to a maximum of about 20 chains diameter. This would assure plenty of seed reaching all parts of the cutover area and during the short periods when slash is dry enough to burn, would be a fire safety factor.

Figure 9.--Clearcutting on the Maybeso Experimental Forest. The mile-square clearcut is beyond the first leave strip.

Table 4.--Stocking of mile-square cutting by zones (1-milacre bands)

	Percent of plots stocked by 10-chain zones				
	0-10	11-20	21-30	30+	Average
Rating system 1					
1957 germinants only	33	27	19	14	27
Both 1957 and advanced	58	60	54	59	58
Rating system 2					
Both 1957 and advanced	26	22	26	38	26

Small mammals

The success of natural and artificial regeneration can be affected adversely by seed-eating mammals. Forest managers need to know what levels of small mammal populations can be tolerated in direct seeding and in planning for natural regeneration. Information is also needed on how control measures should be designed in relation to small mammal population characteristics.

Studies of forest-small mammal relationships have been started in Southeast Alaska in cooperation with the U. S. Fish and Wildlife Service. Published and unpublished sources show that small mammals occurring in Southeast Alaska include three species of shrews (*Sorex*), two species of white-footed mice (*Peromyscus*), and six species of voles (*Microtus* and *Clethrionomys*).

Small mammal population studies on ten 5-acre plots in the Maybeso Experimental Forest clear cutting showed that animal density was as high as six per acre and was greater in the valley bottom sites than on sidehills. Shrew populations were concentrated on the most recently logged sidehill sites. Meadow voles were limited to areas of succulent vegetation.

Populations of from one to three white-footed mice per acre were almost entirely eliminated on two 75-acre plots broadcast-sown with sodium fluoroacetate treated wheat. On the valley bottom sites the reestablishment of original population levels was nearly complete 14 weeks after poisoning. In this period the population on sidehill sites returned to about one-half of the original level. The usefulness of poisoned baits appears to be limited because the population vacuum created is quickly reoccupied.

Direct seeding

The average cutover area will have sites, particularly along streams or valley bottom flats, where brush invasion may preclude or delay natural regeneration. In the absence of a good natural seed crop, such areas may need artificial seeding immediately after logging to establish reproduction before brush competition becomes a problem. Such areas will probably average only about five percent of the total cutover commercial forest land in Southeast Alaska, but they include the most productive sites.

Studies were started in May 1957 on nine one-acre plots seeded by natural seed fall, and artificially with Endrin-treated seed and untreated seed to determine if satisfactory stands of western hemlock and Sitka spruce reproduction could be established by broadcast seeding. Results in the fall of 1957 showed that Endrin may be an effective

treatment to protect broadcast-sown seed from rodents. Plots seeded with Endrin-treated seed had 9,000 hemlock and spruce seedlings per acre. Plots receiving only natural seed fall had 3,000 seedlings per acre, and 3,750 seedlings per acre when supplemented with broadcast-sown untreated seed.

Another study, one in which screened and unscreened seedspots are located on various seedbed types, showed that seedling survival on unscreened spots was 37 to 53 percent of that on screened spots--further evidence of the need for protecting seed from seed-eating mammals.

It would appear from the last two items that there are enough seed-eating small mammals to make it worth while to use Endrin-treated seed for any artificial seeding that is done. Artificial seeding probably will be needed only where there is danger of brush or fern invasion. Most cutover areas will be small enough so that seed will reach all parts and, in addition, will usually have advanced reproduction sufficient to stock them.

1956 and 1957 cone crops in Region 10

A standardized system for rating cone crops was started in Region 10 by adopting the rating system used by the Oregon State Board of Forestry. Cone crops were rated by number from 1 to 10 for each species as follows:

None	- 1	No cones on any trees
	- 2	Few cones on occasional trees
Very light	- 3	Few cones on 25 percent of trees
	- 4	Few cones on 25 percent of trees--many cones on occasional trees
Light	- 5	Few cones on 75 percent of trees
	- 6	Many cones on some trees--few cones on 75 percent of trees
Medium	- 7	Some cones on all trees
	- 8	Many cones on some trees--some cones on all trees
Heavy	- 9	Many cones on 75 percent of trees--some cones on all trees
	- 10	Many cones on all trees

Ratings by species for Southeast Alaska[2/] as determined by averaging the reports from all ranger districts are listed in table 5. Few ratings were made for the less abundant tree species and, although useful, are not as applicable on a regional basis as Sitka spruce and western hemlock.

The annual cone crop reports are used for several purposes. Reports submitted early in the season aid in preparing seed collection programs and interpreting the need for direct seeding. Ratings for a successive number of years should help to establish seed crop periodicity patterns. It is anticipated that a relationship between size of seed crops and factors such as weather may be eventually established.

2/ All areas south of Yakutat.

Table 5.--Average 1956 and 1957 cone crop ratings for Southeast Alaska

Species	Rating		No. observations	
	1956	1957	1956	1957
Sitka spruce	7	2	47	30
Western hemlock	4	6	36	25
Mountain hemlock	6	-	2	-
Western redcedar	8	1	2	2
Alaska cedar	5	1	4	18
Lodgepole pine	5	1	2	3

Seed production in semi-scrub stands

A study of seed fall in a climax pulptimber stand following a bumper seed crop in 1951 showed a production of 91 pounds of seed per acre. The seed was disseminated over a period of more than a year but 87 percent had fallen by the end of November.

In a semi-scrub stand following a medium crop of seed in 1956 about 49 pounds per acre were dispersed from October through the following May. The stand consisted mostly of western redcedar and the amounts were:

Cedar - 36 pounds
Hemlock - 13 pounds, half each of mountain hemlock and western hemlock
Sitka spruce - 1/4 pound

Because of wet weather and early snow the bulk of the seed was dispersed over a longer period than usual. Only 50 percent of the cedar and only 7 percent of the hemlock had fallen by December 30. Cutting tests showed 92 percent soundness for redcedar released before October 30, and 68 percent between October 30 and January 15. Hemlock averaged 40 percent and 25 percent respectively for the same periods.

The prescribed burn at Kina Cove

The question of whether slash on clearcut areas in Southeast Alaska could or could not be properly burned has been discussed for many years. The several thousand acres each in the Skowl Arm burn and in the Karta River burn are pointed to as examples of what could happen. Actually, these two fires happened the same year (1904) and they smoldered all year in scrub and muskeg, according to a few old-timers. Since then there have been no large forest fires in Southeast Alaska, but there have been many small ones, usually after a week or two of dry weather.

None of these consumed more than the finer material, twigs of 1/4-inch or less, and as a measure for getting rid of slash it seemed of little use. Furthermore, there are long periods when it would be impossible to burn. However, no controlled experiments of burning had been made and little was known of the desirability of burning as a silvicultural measure. At Kina Cove, near the Maybeso Experimental Forest, large amounts of slash were on the ground and patches of moss and brush formed a possible obstacle to regeneration. What changes in seedbed conditions would occur as a result of a light surface fire?

The South Tongass National Forest, concerned with the protection of cut-over areas and interested in an opportunity for fire control training, joined the Center in planning the project. They conducted the actual burn for fire control training and timber stand improvement. The location selected had a logging road and a creek for control on two sides, and a bulldozer line was built on the third side. The fourth side was wet down with gasoline-powered pumps.

On July 18, 1957 after six rainless days, the slash was considered dry enough to burn. The half-inch fuel moisture sticks read 10 percent by late afternoon. At 4:30 p.m. a pile of slash was ignited at one end of the area and the fire crept slowly through the adjoining logging debris. As the wind rose to 10 miles per hour, the fire picked up and was carried forward at 600 to 1,000 feet per hour. Snags and spotting aided the fire's spread, and it jumped the creek to another slash-covered area. Control was not difficult since the fire went out when it reached green timber.

Examination of the burned area shows that only the finer material (1/4-inch or less) was consumed. Moss was charred on the blackened areas, but this char did not penetrate more than 1/4-inch. The test shows that such areas will burn, though the burn is not severe. Whether the change in seedbed conditions will benefit regeneration remains to be seen. Endrin-treated seeds of Sitka spruce and western hemlock have been planted on a variety of burned and unburned seedbeds. Germination and early growth of these seedlings will be followed for several years to determine whether or not the changes in seedbed condition have been beneficial.

Cull Factors for Southeast Alaska

Information on cull factors for Sitka spruce, western hemlock, and western redcedar was obtained and Station Paper No. 6[3] published as a result of Dr. J. W. Kimmey's detail from the California Station to Alaska. Most board-foot cull and all cubic-foot cull was found to be due to decayed wood, either brown rot or white rot in either the incipient or later stages.

3/ Kimmey, James W. Cull factors for Sitka spruce, western hemlock, and western redcedar in Southeast Alaska. Alaska Forest Research Center, Station Paper No. 6, August 1956.

The most damaging brown rots were Fomes pinicola and Polyporus sulphureus. Of the white rots, Fomes pini, Armillaria mellea, Fomes annosus, Poria wearii, and P. albipellucida were the most damaging.

Figure 10.--(Left), Fomes pinicola on upper bole. Figure 11.--(Right), Scar on western hemlock from deep wound, and cross section from 40 feet above ground showing rot caused by Fomes pinicola entering through basal wound.

Fomes pinicola caused 88 percent of the losses due to brown rot and nearly three-fourths of the cull in Sitka spruce (figs. 10 and 11). More than three-fourths of the cull in western redcedar was due to incipient white rot--a type of defect that may have a limited use in both lumber and pulp manufacture.

Kimmey's tables of defect on pages 22, 23, and 24 of Station Paper No. 6 show the percentage of the gross board foot and cubic foot volume that is cull in trees from 11 to 78 inches d.b.h. Board foot figures are to

a utilized top and to an 8-inch top. Cubic foot figures are for a utilized top and a 4-inch top. These are shown for trees (1) with no indication of rot, (2) with either the lower or the upper section (that part above the first 32-foot log) showing indicators of defect, and (3) with both sections showing indicators. He lists reliable indicators of cull.

The Forest Survey has found it helpful to show these tables in terms of percent of gross volume that is merchantable so that the figure can be applied directly to gross volume. These are shown to a fixed top in table 6.

Although Kimmey's tables of defect are regional and may not be perfect for any one timber sale area, the chances are pretty good that his figures are better even for local use than the estimates of any forester not trained in forest pathology.

The comparison of board foot and cubic foot figures in table 6 shows just one more reason for discarding the antiquated Scribner board foot rule. Note, for example, that a 28-inch d.b.h. hemlock tree with both lower and upper bole sections showing rot indicators has a merchantable board foot volume of only 50 percent. The same tree has a merchantable cubic foot volume of 80 percent. The cruise, in board feet, will show less than is actually there in pulpwood. The tree is apt to be left unutilized because it hasn't boards enough in it, but the sale may be for pulp. If it is taken out of the woods, the scale by Scribner will cull much of it, but still the pulp is there. The board foot rule measures less in the raft than will actually be taken and used for pulp.

Tree Decomposition Rates

How long has this tree been dead? The answer to this question is needed to permit estimates of natural mortality in making forest surveys or cruises in old-growth stands. A study of tree decomposition rates is the first step in developing guides to the estimation of natural mortality.

Seventy-one trees, poisoned or girdled in a stand improvement study, have been observed annually since 1950. The rate of decomposition of the needles, branches, bark, etc. has been expressed as a percentage each succeeding year. A loss of 25 to 75 percent is described as "half gone". "Nearly gone" is 75 percent loss, and "completely gone" is, of course, a 100 percent loss.

Seven years after death the trees appear as follows:

Table 6.--Percent of gross volume that is merchantable

Dbh	Board feet to 8-inch top									Dbh	Cubic feet to 4-inch top								
	Hemlock Indicator sections			Spruce Indicator sections			Redcedar Indicator sections				Hemlock Indicator sections			Spruce Indicator sections			Redcedar Indicator sections		
	0	1	both	0	1	both	0	1	both		0	1	both	0	1	both	0	1	both
12	96	76	73	99	73	4	58	53	22	12	99	91	94	99	87	18	84	72	35
14	96	76	70	99	72	4	57	53	22	14	99	91	93	99	87	19	83	72	35
16	96	76	68	99	72	5	56	52	22	16	99	91	92	99	87	20	83	71	35
18	96	75	65	99	72	5	56	51	22	18	99	91	91	99	86	22	82	70	35
20	96	75	62	99	72	6	55	50	22	20	99	91	89	99	86	24	81	69	34
22	95	74	60	99	72	7	53	48	22	22	99	91	88	99	86	26	79	68	34
24	95	73	56	99	71	8	52	47	21	24	99	90	85	99	86	27	77	66	34
26	93	72	53	99	71	10	51	44	21	26	98	90	83	99	85	30	75	65	33
28	92	71	50	99	71	11	50	42	20	28	98	89	80	99	85	32	72	62	32
30	91	69	47	99	71	13	49	39	20	30	97	88	77	99	85	34	68	59	32
32	90	67	44	99	71	14	48	35	19	32	97	87	73	99	85	37	64	55	31
34	88	66	41	99	71	16	47	32	18	34	96	86	70	99	85	40	61	51	30
36	86	64	38	99	71	18	46	28	16	36	95	85	66	99	85	43	58	47	29
38	84	63	35	98	71	21	45	24	15	38	93	83	62	99	85	46	55	43	27
40	83	62	32	98	71	23	45	20	13	40	92	82	59	99	85	48	54	38	24
42	81	60	30	98	71	25	44	17	11	42	90	80	55	99	85	51	53	33	20
44	80	59	27	97	72	28	44	14	9	44	89	78	51	99	85	53	52	29	16
46	78	58	25	97	72	30	44	11	7	46	88	76	48	99	85	56	52	24	12
48	76	57	23	97	73	33	44	8	5	48	86	74	45	98	85	58	51	21	8
50	75	56	20	97	73	35	43	6	3	50	84	73	42	98	85	60	51	18	4
52	73	55	18	97	74	36	43	4	2	52	83	71	39	98	85	62	51	15	2
54	72	53	17	97	75	38	43	3	1	54	81	69	37	98	85	64	51	12	1
56	70	53	15	96	76	39	43	2	0	56	79	67	34	98	85	65	51	10	0
58	69	52	14	96	77	40	43	1	0	58	77	65	32	97	85	66		9	
60	68	51	13	96	77	41	43	0	0	60	76	63	31	97	86	67		7	
62	66	50	12	96	78	41	43	0	0	62	74	61	29	97	86	68		6	
64	65	50	11	95	78	41	43	0	0	64	70	59	28	97	86	68		5	
66	63	49	11	95	78	42	43	0	0	66	68	58	27	97	86	69		4	
68	62	49	10	95	79	42	43	0	0	68	67	56	26	97	87	69		3	
70	60	48	10	95	79	42	43	0	0	70	65	54	25	97	87	69		3	

Western hemlock

Needles absent
Branchlets half gone
Secondary branches half gone
Primary branches partly gone
Bark intact
Bole largely intact, considerable top break

Sitka spruce

Needles absent
Branchlets half gone
Secondary branches half gone
Primary branches partly gone
Bark partly gone
Bole largely intact, some top break

Western redcedar

Needles absent
Branchlets nearly gone
Secondary branches half gone
Primary branches partly gone
Bark intact
Bole intact

Fluting of Western Hemlock

Fluting of western hemlock may become a serious problem in young-growth stands in Southeast Alaska. Fluting is sometimes so pronounced that no merchantable sawtimber can be obtained and even pulping would be difficult if not impossible (fig. 12). All of the hemlock in a stand may be affected and it appears that the most vigorous stems are most severely fluted. Stands such as the one shown in fig. 13 offer little incentive for harvesting, are producing little merchantable volume, but often occupy highly productive sites.

The cause of fluting in western hemlock in this region is not known. An exploratory study is being started in an attempt to establish a relationship between fluting and anatomical characteristics, such as branch gaps or early growth suppression. It is hoped that an early understanding of the cause of fluting may lead to silvicultural practices which can largely eliminate it in future stands.

Figure 12.--A severely fluted western hemlock.

Figure 13.--Fluted western hemlock in a 123-year-old stand, site index 140.

Silvical Leaflets for Alaska Trees

The Forest Service, Division of Forest Management Research, in Washington, D. C. is supervising the development of silvical leaflets or pamphlets for all commercial tree species. These are being issued mostly as station papers by the various regional forest experiment stations in the States. The tree species of commercial value in Alaska mostly occur to a larger extent in other regions; hence the Alaska Forest Research Center is responsible for only one--Alaska-cedar. A station paper on this species will soon be issued. A short digest of what has been accumulated on Alaska-cedar may be of value.

Silvical Characteristics of Alaska-cedar

This species, occurring only as a minor part of the stands of Alaska, has not yet been studied. What is now known about it is roughly summarized below. As it will be the only cedar component of the stands in the Juneau and Sitka units, its reproduction and growth habits must be studied.

Alaska-cedar is a Pacific coast species that ranges from a few isolated spots in northern California north to a latitude of 61° N. in Prince William Sound in the Gulf of Alaska. It is confined to cool, humid climates and is thus found only at high elevations in the southern part of its range. Progressing northward, its lower elevational limit gradually descends until it reaches tide water at about 51° north latitude just north of Vancouver Island. In much of its range in Alaska this species occurs from sea level to timberline.

Alaska-cedar apparently can grow on extremely poor soils if there is abundant soil moisture. It is found on heavy, wet azonal organic subalpine soils, or muskegs, in half-bog soils, and lithosols. Its best development in Alaska occurs at higher elevations near the upper limits of merchantable timber on thin organic soils with plentiful ground water. Alaska-cedar is rarely found on deeper well-drained soils, because on better sites it cannot compete with the more aggressive Sitka spruce and western hemlock.

In the northern portion of its range, Alaska-cedar cones mature in two years. In the southern part of its range, and perhaps in certain races, the cones may mature in one year. The seed ripens in late September in Alaska and is dispersed during drier periods in the fall and early winter. In Alaska some seed is produced nearly every year with moderate to good crops every two to four years. The germinative capacity is quite low, from 22 to 57 percent. Germination and seedling growth is best on mineral soils, damp moss, and muck.

Alaska-cedar is a slow-growing, long-lived tree capable of growing to ages of over 3,000 years. It is believed to be less tolerant than western redcedar and western hemlock.

The volume of Alaska-cedar in Alaska, occurring mainly in mixture with other species, is estimated to be 2 billion board feet. The wood is durable and decay-resistant. It is highly prized for boat building. The fine uniform texture, excellent machinability, and good finishing properties of Alaska-cedar make it a suitable wood for interior finish and turned products.

During the past few years new silvical information on western redcedar has been obtained. In March 1953 Andersen added new data on the range of western redcedar in Technical Note No. 22. In 1955 he extended the board foot form class volume tables for cedar and made preliminary redcedar cubic form class volume tables. In October 1957 Gregory published "Some silvical characteristics of western redcedar in Southeast Alaska" in Ecology. Gradually we are adding to the fund of knowledge about this species at the northern edge of its range.

Redcedar does not reproduce itself to an appreciable extent in well-stocked old-growth stands. Its seeds germinate and young seedlings are numerous but they do not survive (table 8). The direct effect of light or its indirect effect through warming of the site seems necessary for survival of this species in Alaska. Western redcedar at its northern limits is probably very sensitive to slight environmental differences.

Table 8.--Average number of western hemlock and western redcedar seedlings and saplings per acre in six well-stocked old-growth stands

	Seedling Height (Inches)		Sapling Dbh (Inches)	
	Under 6.0	6.0 and over	2	4
Western hemlock	21,437	5,552	200	32
Western redcedar	11,860	78	6	4

A definite relationship between site index and prevalence of redcedar (table 9) was indicated by the fact that the species was much reduced in number on habitats with a site index above 110. It was rare in

Table 9.--Occurrence of redcedar by site index in young even-aged stands

Site index	Total No. of plots	No. of plots with redcedar	Average percent stand basal area in redcedar 1/
66-75	3	100	57
76-85	16	94	22
86-95	15	100	20
96-105	29	97	17
106-115	18	89	12
116-125	38	34	1
126-135	19	1	2/
136-145	3	0	0
146+	1	0	0

1/ Stems 1 inch dbh and larger　　2/ Less than 1

stands with a site index above 130. Basal area followed a similar trend. The percentage of cedar was highest on poor sites and lowest on the better sites.

Areas of young-growth with a low site index and a high proportion of western redcedar often had a fire history. Cedar usually had been present in the pre-fire old-growth.

Leader Growth of Conifers in Alaska and Vancouver Island Compared

A comparison was made to determine if the seasonal distribution of western hemlock leader growth in Southeast Alaska[4/] followed the pattern reported for the Cowichan Lake Forest Experiment Station on Vancouver Island[5/]. The Cowichan Lake report included leader growth data for western redcedar. Observations in both regions were made on trees of sapling size, but dates for commencement of growth at Cowichan Lake were based on phenological records while the Alaska results were from direct measurements on selected trees.

Results of the comparison (fig. 14) show that there is little difference between the two regions in the periodic distribution of western hemlock leader growth after growth begins in the spring. The growth pattern for western redcedar at Cowichan Lake is of interest because no data are available for this species in Alaska. It begins leader growth at about the same time as western hemlock but has a more rapid early growth rate--about 50 percent of the seasonal growth is made during the first four weeks, after which it decreases and finally ceases at about the same time as western hemlock.

Douglas-fir and grand fir at Cowichan Lake cease growing earlier and more abruptly than western hemlock and western redcedar. Sitka spruce, which, like Douglas-fir and grand fir, has a rigid leader, shows the same growth characteristics in Alaska.

The Great Soil Groups of Southeast Alaska

A study designed to provide descriptive data for some of the great soil groups of Southeast Alaska, principally those encountered on the Maybeso Experimental Forest, is currently under way. During the past several

---

4/ Godman, R. M. and R. A. Gregory. Seasonal distribution of radial and leader growth in the Sitka spruce-western hemlock forests of Southeast Alaska. Jour. Forestry 53(11):827-33, 1955.

5/ Buckland, D. C. Terminal growth of four western conifers for a single growing season. For. Chron. 32(4):397-399, 1956.

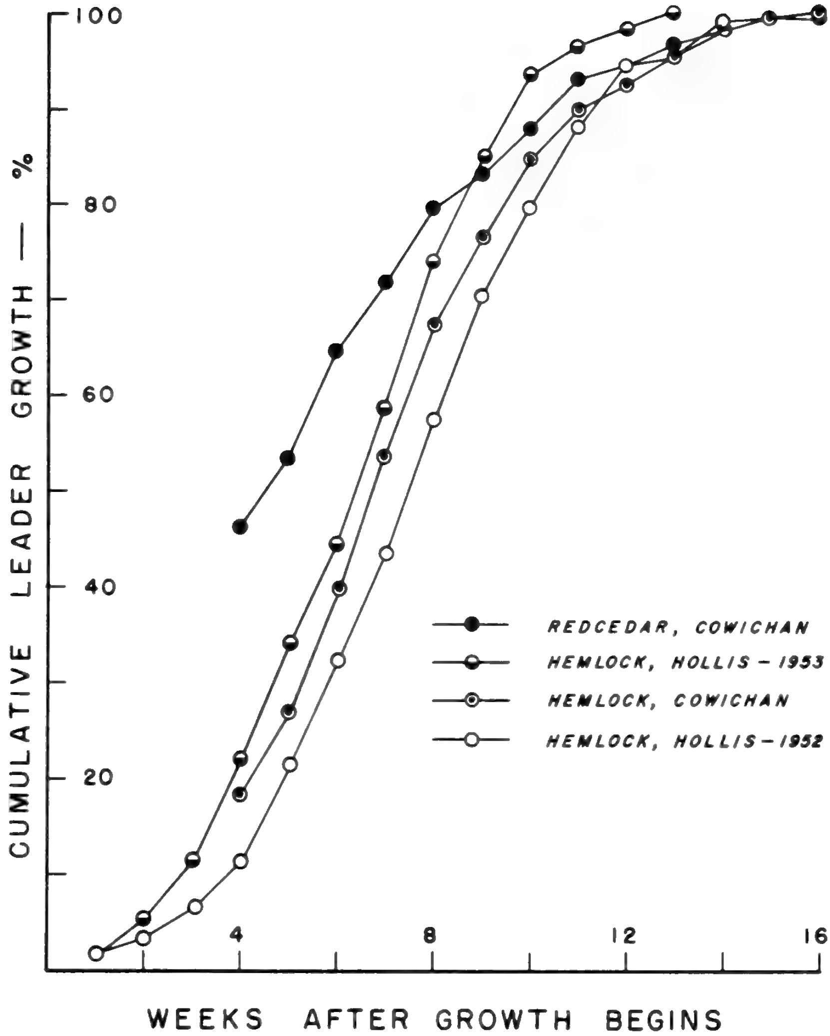

Figure 14.--Seasonal distribution of leader growth.

years of forest research activity in this region, considerable knowledge has been gained concerning the extent and characteristics of the more prominent soil types. Specific vegetation and physiographic features are often associated with their occurrence. Unfortunately, little work has been done to adequately describe these soils.

The great soil groups and some of their variants which have been observed in Southeast Alaska are:

1. Zonal soils

    a. Podzol

        (1) Till or slope podzol
        (2) Outwash or well-drained valley bottom podzol

2. Intrazonal soils

    a. Half-bog
    b. Bog
    c. Alpine meadow
    d. Brown forest

3. Azonal soils

    a. Lithosol
    b. Alluvial

A detailed description of physical and chemical properties of important soils should contribute to an understanding of the silvical requirements of forest stands. Accordingly, an attempt is being made to obtain representative samples of all of the following soils:

Till or slope podzol
Outwash or well-drained valley bottom podzol
Half-bog
Brown forest
Lithosol

Sampling has been completed for two slope podzols, two valley bottom podzols, two half-bog, and one lithosol profile. Laboratory analyses are partly completed for these samples. Field work and laboratory analyses are expected to continue during 1958.

A New Quick Cruise Method

Foresters have always been interested in methods for determining stand volumes quickly and with consistent accuracy. Rapid techniques are usually employed for such problems as determining the merchantability or timber type of a stand where these features are defined by volume. The old method of ocular estimation, based upon extensive experience, meets with less favor in the modern day of confidence limits and the determination of sampling error.

One system of quick cruising, developed at this Center, was Godman's quick cruise method[6/]. It was based on averaging many plots with similar number of trees per acre, average d.b.h., and number of logs.

A more recent method consists of measuring or estimating diameters by 2-inch classes and the number of logs in each tree on a fifth-acre plot and simultaneously accumulating volumes per acre on the plot by using a special circular slide rule. The slide rule, described in Alaska Forest Research Center Technical Note No. 37, was designed for Sitka spruce and western hemlock of form class 82 and western redcedar of form class 75. Other form classes can be used.

Site Index Determination in Even-aged Sapling and Pole Stands

Site index determined by the usual method of height-age relationships is unreliable in stands less than 30 years old in Southeast Alaska. Consequently, estimates of site productivity and future yield cannot be made by this method in young stands.

A method for using internodal span for determining site index in juvenile Douglas-fir stands was suggested by Wylie[7/] and developed by Warrack and Fraser[8/]. The applicability of the procedure in this region is being studied using internodal span of Sitka spruce.

The lengths of 6-node spans, beginning with the first node above breast height, were measured in young-growth over 30 years old and compared with site index determined by the height-age method. The indications are that a fairly consistent site index determination can be obtained by reference to internodal span. Initial results show that site index can be determined to within 20 feet of the height-age method 83 percent of the time. The tabulation below shows the range of differences in site index determined by 6-node span as compared with the conventional height-age method on 23 plots.

6/ Godman, R. M. A site classification and "quick cruise" volume table for climax stands. Alaska Forest Research Center, Tech. Note No. 11, 3 pp., 1951.

7/ Wylie, N. A. Determining site index in young Douglas-fir stands. Thesis submitted in partial fulfillment for requirements of British Columbia Registered Foresters' Association. (Cited by Warrack and Fraser, below.)

8/ Warrack, Y. C. and A. R. Fraser. Estimation of site quality in juvenile Douglas-fir stands. British Columbia Forest Service, Research Note 28, 5 pp., 1955.

Range of difference between 6-node span and height-age determination feet	Number of plots
0 - 10	11
11 - 20	8
21 - 30	4
Total	23

Additional tests are contemplated. At present it does not appear that internodal span can be used for precise estimates of site index. However, it may be a useful procedure for general management purposes where broad productivity classes are used.

Further Tests of Yield Tables

The Southeast Alaska yield tables were checked in 1949 as to growth, predicted and actual, over a 25-year period.[9/] They were found to be reasonably accurate. During the past two years additional plots were measured to compare actual volumes of the plots with those given in the tables for the site indices and ages. These averaged 94 percent of the merchantable cubic volume, and 106 percent of the basal area, given in the yield tables. Complete volumes of plots and of strips to be run through bodies of second-growth will give a firm answer as to yield table accuracy.

The yield tables indicate in a general way that in 100 years on an average site, second-growth stands will have almost twice the volume of the average climax stand. This is a generalization of many complex factors. For example, it is assumed that a second-growth stand should be old enough to be composed mostly of trees 7 inches d.b.h. and larger before cutting, to avoid waste. This varies tremendously by site index as shown by the following table:

Table 10.--Age when basal area of 7" + trees is 90 percent of total basal area

Site index	Age required - years
70	132
90	100
110	74
130	60
150	55

9/ First records of growth for Southeast Alaska's young stands. Tech. Note No. 1, Alaska Forest Research Center, March 1949.

It also assumes that the Forest Service will not ignore the true volume in trees between 7 and 11 inches d.b.h. by measuring them in the year 2040 by the Scribner rule. It is also assumed that the non-growing climax will be liquidated before cutting any of the fast-growing young stands.

The yields, of course, will not seem as great as predicted, (but the logger will be cutting them) (1) if the Scribner rule is used, (2) if defect is deducted in any large amount--thrifty second-growth has almost none, and (3) if breakage is deducted. Breakage is a risk the logger runs--it is not loss of volume until he makes the loss. It would be a very small item in thrifty second-growth.

Primary Stands of Coastal Alaska

Primary stands are the original forest stands occupying recently exposed land. Uplifting from below sea level and deposition between the mainland and raised longshore bars are believed to be the origin of the Yakutat foreland, an area of recently exposed land supporting a primary stand of about five and one-half billion board feet of commercial timber. The Yakutat foreland is a part of the North Tongass National Forest. One larger area of primary stands, on recently exposed land resulting from glaciation, is within the Glacier Bay National Monument. This area is closed to commercial exploitation but the stands are of silvicultural interest because of a number of smaller areas elsewhere that support commercial forests.

Early results of a study, currently in progress, indicate that the development and growth of primary stands differ appreciably from stands succeeding the removal of previous generations of forest. Undeveloped soils of recently exposed lands contain little organic matter, are usually of coarse texture, and because of low cation capacity they have few available nutrients. Forests developing on these soils grow slowly, particularly in their early years.

Primary stands on raised beaches in the Yakutat area are usually pure Sitka spruce (figs. 15 and 16). Apparently, the original seedbed is more favorable for spruce than for other conifers. A herbaceous understory develops as natural thinning opens the crown canopy. By a stand age of 100 years the understory is usually well-developed (fig. 17). Western hemlock also appears in the understory where a seed source is available. Stand development seems to tend toward a spruce-hemlock forest.

Early vegetation on recently glaciated lands is most commonly cottonwood or alder stands or stands of mixed brush species. Cottonwood and alder stands are short-lived and soon have an understory of spruce or spruce-hemlock (fig. 18). Young stands with heavy brush competition

Figure 15.--A dense young stand of Sitka spruce on the Yakutat foreland.

Figure 16.--Fifty-year-old Sitka spruce on the Yakutat foreland.

Figure 17.--Dense stand of devils club, currant, and salmonberry under a 120-year-old primary stand of Sitka spruce at Yakutat.

Figure 18.--Sitka spruce understory in a cottonwood stand on a recently glaciated area.

develop slowly and are often poorly stocked and patchy. Such stands may develop into fairly well-stocked hemlock-spruce forests but it will probably require a much longer period than for stands on raised beaches.

A study is in progress to obtain information on growth and yield for adjusting the existing Southeast Alaska yield tables to Yakutat foreland conditions.

Forest Management Research in Interior Alaska

Our 1955 annual report described the broad forest research needs in Alaska's interior forests. Forest management research in the Interior began in the summer of 1957 with a reconnaissance of the more accessible areas. More than one dozen growth and yield plots and several silvicultural and silvical plots were established to become more familiar with the types and to provide a basis for the design of specific studies for the next few years and the development of a research program for the future.

WATERSHED MANAGEMENT STUDIES

Pulp Logging on Salmon Spawning Streams

Pulp logging has so far shown no measurable effects on salmon streams. Logging has been in progress since August 1953 on Maybeso Creek, one of five streams in the study of effects of logging on salmon spawning streams. About 60 percent of the merchantable timber was felled and 46 percent yarded as of March 1957.

Mean monthly discharge of Maybeso Creek during the first three years of the transition period from an unlogged to a logged watershed condition was almost the same as for the prelogging period. This actually represents a small net increase in discharge because precipitation averaged 10 inches less per season (May through October) during the transition period than during the prelogging period. The discharge of Harris River, an unlogged watershed adjacent to Maybeso Creek, showed the effects of the reduced precipitation amounts.

The tiny net increase in Maybeso Creek discharge occurs during the period of normal low flow. The effect may be beneficial for silver salmon fry that remain in fresh water for one year before entering salt water. Higher stream stages during the period of normal low flow also might help early spawners to migrate upstream.

Three years of logging has had no effect on the water temperature of Maybeso Creek. Average annual water temperatures during the transition period are colder by about one degree than those during the prelogging

Figure 19.--Use of suspended sediment sampler.

period. Comparisons with the water temperature of unlogged Harris River also show that logging has not caused changes in stream temperatures.

Suspended sediment sampling during spring, summer, and fall at various stages on all of the five study streams show that the concentrations are very low. Sediment production in Maybeso Creek has not been any greater than in any of the unlogged study streams. A flood stage of 4.82 feet resulted in a suspended sediment load of only 11 p.p.m. in Maybeso Creek.

Prelogging results were published in Station Paper No. 5 in September 1956. Results of the study during the transition period from unlogged to completely cut over will be summarized during the winter of 1958-59.

LIST OF PUBLICATIONS, 1956-1957

USDA Publications

Lutz, H. J.
Ecological effect of forest fires in the Interior of Alaska. Tech. Bull. No. 1133. 121 pp., illus. March 1956.

Station Papers

Gregory, R. A.
The effect of clear cutting and soil disturbance on temperatures near the soil surface in Southeast Alaska. No. 7. 21 pp.

James, G. A.
The physical effect of logging on salmon streams of Southeast Alaska. No. 5. 49 pp. September 1956.

Kimmey, James W.
Cull factors for Sitka spruce, western hemlock and western redcedar in Southeast Alaska. No. 6. 31 pp. August 1956.

Technical Notes

Andersen, H. E.
Cubic foot volume table for spruce and hemlock pole-timber. No. 29. 1 p. March 1956.

____
The problems of brush control on cutover areas in Southeast Alaska. No. 33. 2 pp. July 1956.

_______________, and J. E. Weisgerber
Use of long-log scaling tables in Southeast Alaska. No. 32. 2 pp. March 1956.

Gregory, R. A.
1956 cone crop report for Alaska tree species. No. 35. 2 pp. March 1957.

____
A comparison between leader growth of western conifers in Alaska and Vancouver Island. No. 36. 2 pp. March 1957.

____
The accuracy of Southeast Alaska site index estimates associated with variable numbers of height measurements. No. 38. 2 pp. March 1957.

Harris, A. S.
The quick cruise circular slide rule. No. 37. 3 pp., illus. March 1957.

James, G. A.
The rodent problem on cutover areas in Southeast Alaska. No. 31. 2 pp. March 1956.

____
The effect of logging on discharge, temperature, and sedimentation of a salmon stream. No. 39. 2 pp. March 1957.

McCambridge, W. F.
A record of spruce cone insects in Alaska. No. 34. 2 pp. March 1957.

McGregor, R. C.
Fire weather measurements in Southeast Alaska, 1955. No. 30. 2 pp. March 1956.

Articles in Print

Andersen, H. E.
Use of twin low-oblique aerial photographs for forest inventories in Southeast Alaska. Photogramm. Engin. XXII(5):930-934.

__________, and G. A. James
Watershed management and research on salmon streams of Southeast Alaska. Jour. For. 55(1):14-17.

Gregory, R. A.
Some silvical characteristics of western redcedar in Southeast Alaska. Ecol. 38(4):646-649.

Lutz, H. J.
Damage to paper birch by red squirrels in Alaska. Jour. For. 54(1):

Taylor, R. F.
Alaska. Chapter 6 of "A world geography of forest resources". Am. Geo. Soc. Special Publ. No. 33. pp. 115-125.

Processed Material

Andersen, H. E.
Watershed management practice and research on salmon streams of Southeast Alaska. 4 pp. mimeo. January 1956.

Caporaso, A. P.
Forest inventory statistics for the Juneau timber management unit of the North Tongass National Forest. Forest Surv. Report No. 1. 24 pp. mimeo. March 1957.

Caporaso, A. P.
Semiannual progress report on watershed management studies, September 1956-April 1957. 3 pp. mimeo.

______________, and P. M. Haack, Jr.
A comparative analysis of three aerial photo film types. 12 pp. typed. December 1957.

Downing, G. L.
Forest insect conditions in Alaska, 1956. 3 pp. mimeo. December 1956.

____
Forest insect aerial survey, Southeastern Alaska, July-October 1956. 6 pp. mimeo. December 1956.

____
Forest insect aerial survey, Alaska, July-September 1957. 5 pp. mimeo., October 1957.

____
The recent history of destructive forest insect activity in Alaska. For. Insect Surv. Report No. 1. 4 pp. mimeo. December 1957.

____
An *Ips interpunctus* infestation in white spruce of northern interior Alaska. For. Insect Surv. Report No. 2. 4 pp. mimeo. December 1957.

Gregory, R. A.
Some silvicultural characteristics of western redcedar (*Thuja plicata* D. Donn) in Southeast Alaska. 3 pp. mimeo. September 1956.

James, G. A., and R. C. McGregor
Some forest regeneration problems following clearcutting in Southeast Alaska. Mimeo. September 1956.

GPO 990785